K569-02 MIS – FUNCTIONAL DESCRIPTION

OSC-80-SB-X-XX-0000X

1107304/5 OCEAN SPACE CENTRE

Project	Ocean Space Centre
Client	Statsbygg
Issued by	Statsbygg
Date of print	01.03.2024
Last revision	01.03.2024
Enquiries can be directed to	Statsbygg Postboks 232 Sentrum, 0103 Oslo Telefon: 22 95 40 00 Epost: postmottak@statsbygg.no Internett: http://www.statsbygg.no

PROJECT OCEAN SPACE CENTRE

MIS FUNCTIONAL DESCRIPTION

01	01.03.2024	Draft for review			TAH	EH	ØR
Version	Date	Text			Prep by	Checked by	Approved by
Project number: XXXXX	**Issued by:** **tah**	**Project name** **Ocean Space Centre**	**Code:** **O**	**Document type:** **XXXX**	**Document code:** OSC-80-SB-X-XX-0000X		**Version:** **03**

1 Table of Contents

2 Introduction

2.1 Objective

This document shall define what Main Interlocking System (MIS) is, and provide a summary of the purpose, functionality, and role within The Norwegian Ocean Technology Centre (NOTC).

2.2 Background

The NOTC is a new ocean technology centre planned for Trondheim. It will play an important role in creating future value in the ocean industries and make an important contribution to the transition to green.

Amongst other things, the project includes laboratories with highly specialised equipment such as several large pools in which testing and research can be conducted for example, for wind turbines, fish cages, solar islands and ships. NTNU and SINTEF will also have new workplace and educational facilities built.

The centre will replace the marine technology centre currently located in Tyholt and will also be establishing itself at Trondheim biological station in Heggdalen.

NOTC consist of following buildings:

- Tankhodet
- Kavitasjonslaboratoriet
- Professor Mørchs hus
- Arkimedes' hus
- Bassengbygget (translated to basin building)

Figure 1 Overview picture of NOTC

The MIS solution will only cover user equipment installed in Bassengbygget.

2.3 Definition of MIS

MIS is a safety and control mechanism which shall ensure that certain conditions and/or positions are met, and specific sequences of events occur before a particular action or process is allowed to proceed within NOTC.

The primary purpose of MIS is to enhance safety, protect equipment, and prevent potentially hazardous situations. The system is essential since the coordination of the processes is critical for safe operations.

Systems connected to MIS will request permission to initiate operation, and shall report realtime status on relevant sensors. If the criteria for starting a process are not met, or sensor data from a running system reveals that relevant criteria are no longer met, MIS will deny or intervene.

Thus, MIS shall not drive any equipment or be a fault monitoring system. MIS shall be able to stop, shutdown or prevent start of machines in case there is risk of collisions or potential hazards.

In modern automated systems, the MIS is typically integrated with the overall control system architecture, such as Programmable Logic Controllers (PLCs), allowing it to communicate and coordinate with various parts of the system efficiently.

See chapter *4 MIS Scope, Functionality, and Interlock Matrix* for a more detailed description of MIS.

2.4 Abbreviations and contract numbers

Abbreviation	Explanation
NOTC	The Norwegian Ocean Technology Centre
Company	Statsbygg, which is the Norwegian government's key advisor in construction and property affairs, building commissioner, property manager and property developer.
Contractor	Means the party named as such in the Form of Agreement.
Subconctractor	Means a Third Party who has entered into an agreement with the Contractor for the supply of goods or services in connection with the Work.
End-user	SINTEF Ocean and NTNU.
Work	Means all work which Contractor shall perform or cause to be performed in accordance with the Contract
Company Materials	Means equipment, systems, and/or materials supplied by Company and which are to be incorporated in the Contract Object.
NOTC	The Norwegian Ocean Technology Centre
EPC K203	EPC contractor for construction of building B.
Interlock	In NOTC is an interlock defined as a safety mechanism or system designed to prevent unintended or unsafe operations.
MIS	Main Interlocking System. refers to a safety mechanism or system designed to prevent unintended or unsafe operations within NOTC
IEC 62443	IEC = International Electrotechnical Commission. IEC 62443 is a series of guidelines and best practices for the security of industrial automation and control systems (IACS).
IT	Information Technology (IT). IEC 62443 don't have a clear definition on IT systems. In general IT refers to physical computers, storage, and networks used to handle electronic data. It's the systems that process and store an

Abbreviation	Explanation
	organization's information, making it accessible to business applications and users. Example but not limited to Outlook, Word, CRM systems, Microsoft 365, internet and internet lines.
OT	Operational Technology (OT). IEC 62443 defines OT as the technology and systems used to manage and control industrial processes and critical infrastructure. IT and OT systems are therefor
OB	Ocean Basin
SMB	Seakeeping and Maneuvering Basin
FRC	Fast Running Carriage
WAS	Wave Absorption System
WGS	Wave Generation System
HLCC	Hydro Laboratory Centralized Control
GVS	Guides Vanes Screens
MF	Movable Floor
MMC	Multi-motion carriage
RMC	Roof Mounted Carriage
WPS	Work Platform System
TDG	Trim Dock Gate
CS	Current System
GVS	Guides, Vanes, and Screens
EP	Trim Dock Elevation Platforms
BUT	End-User equipment
ESD	Emergency ShutDown system
MOCAP	Motion Capture Equipment for recording experiments

2.5 References

- OSC-80-SB-O-SD-00003 Tagging requirements
- OSC-30-SB-O-SD-00008 Grensesnittsbeskrivelse / Interface Description

3 Basin building and user equipment.

3.1 Basin building

The basin building in NOTC consists of 3 main areas

- OB = Ocean Basin
- SMB = Seakekeeping and maneuvering basin
- Offices, workshops and storage area.

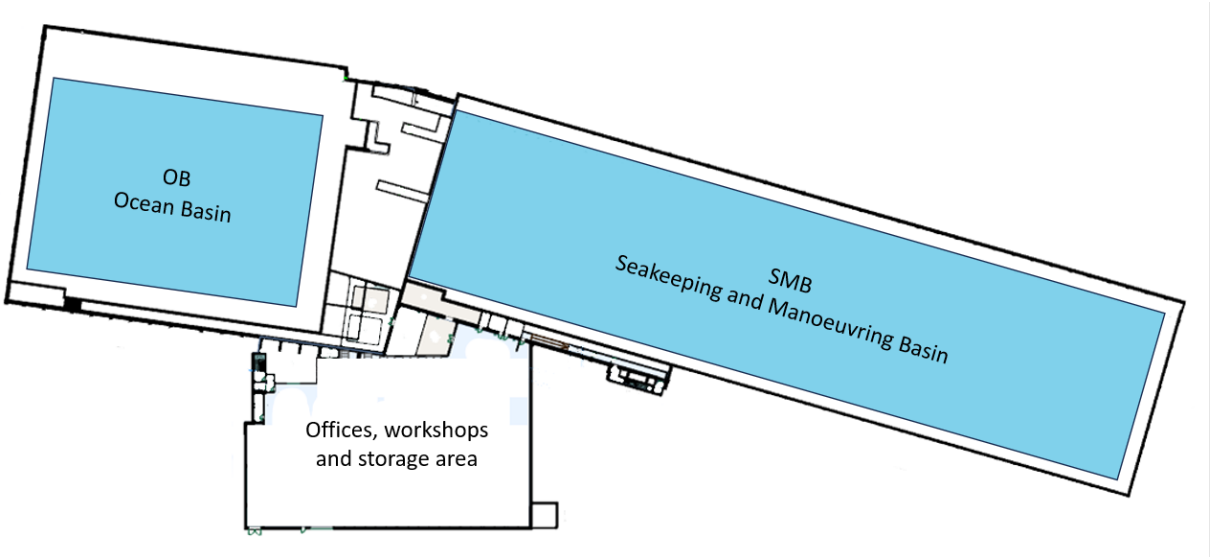

Figure 2 Basin building

MIS shall only control user equipment installed in OB and SMB. In addition, there are two (2) Control Rooms: one for SMB and one for OB.

3.2 BUT - User equipment

The relevant user installed equipment consists of cranes, carriages, movable floors and platforms, current- and wave generation systems, as well as various platforms and gates. These are used for running experiments, and will typically be controlled and monitored remotely by the HLCC system via the control rooms. Experiments may run for several days. MOCAP equipment will be running simultaneously.

3.2.1 Systems, including relevant BUT

Contract Number	Name	Location	Vendor	Functional Description
K203	Fire Alarm System	Both	HENT AS	Building centralised fire alarm system.
K203	Water Treatment Plant	Both	HENT AS	The water treatment plant ensuring supply of water at rate and quality to requiring systems.
K203	K203 Wall crane	OB	HENT AS	Wall mounted crane in OB to assist with lifting operations.

Contract Number	Name	Location	Vendor	Functional Description
K203	Other building systems	Both	HENT AS	Building components, concrete, infrastructure etc.
K203	Building access control system	Both	HENT AS	The centralised access control system ensuring only authorised personnel can operate doors and other access methods to the facility.
K203	Building automation Systems	Both	HENT AS	Building automation systems governing HVAC, lighting, etc.
K569-01	HLCC Sintef Ocean	Both	Sintef AS	HLCC - Hydro Laboratory Centralzed Control - is a software framework for running experiments and operates as a versatile and scalable control system.
K569-02	MIS	Both		A solution that shall ensure that certain conditions and/or positions are met, or specific sequences of events occur before a particular action or process is allowed to proceed within NOTC.
K661-02	Current System - GVS	OB		Minimize secondary flow and eddies, Flow conditioning (guides-vanes-screens), «Guide» the water flow from the pumps through the channels and into the basin.
K661-03	Current System - Pumps	OB	Framo AS	The current system consists of a set of 96 pumps which circulates water through the basin and return channels. The pumps can be individually speed regulated to make up wanted velocity-profiles in the basin for different experiments. Normal operation is a steady state flow within the channels/basin with pumps at set speeds. Time to reach steady state is expected to be long (hours).
K662-02	Wave Generation Units	OB	Van Halteren Technologies	Used to generate waves within OB, with 111 fixed segments and 98 height adjustable segments.
K662-03	Wave Generation Units	SMB	HR Wallingford Ltd.	Used to generate waves within SMB. Consists of 2m wide wavemaker units, 84 arranged in a line along the east wall and 20 arranged in a line along the north wall.
K663-01	WAS	OB	AXtech AS	Absorbs waves generated by the north and east side wave generators Guides the flow of current into the GVS system (south only). Closes off the west beach while running north-south waves only. - South beach with stationary and movable sections - Stationary beach in southwest corner - West side beach with stationary and movable sections
K663-02	WAS	SMB	HR Wallingford Ltd.	The wave absorption system is installed along the west and south sides of the basin to prevent reflected waves causing interference and reducing the wave quality within the SMB.
K664-01	Movable Floor Systems	Both	AXtech AS	Movable floor in basins, with flaps in some ends. Used to configure the basin for model tests representative at given water depths, establish a sufficiently planar, smooth, and stable lower boundary for testing and support of test models, and provide connection points and/or foundation for models and test equipment.
K665-01	Multi Motion Carriage	SMB	HR Wallingford Ltd.	The carriage system shall cover a large range of functionalities - traditional towing tank configurations, seakeeping tests and manoeuvring tests, and testing of moored installations, both above and below water surface. The facility will be used also for testing of other types of objects.
K665-03	Fast-running Carriage	SMB	Van Halteren Technologies	FRC is secondary carriage in the SMB supplementing the main towing carriage. Operates from TDG 2, potentially at high speeds on a rail system along one of the walls.

Contract Number	Name	Location	Vendor	Functional Description
K665-05	Roof-mounted Carriage	OB	Van Halteren Technologies	RMC is used to follow free running models in the Ocean Basin. It contains measuring and monitoring equipment. It can be used for remote/unmanned operations of test objects. Manriding: operator in driver seat Parked: accessible for persons
K665-05	Work Platform System	OB	Van Halteren Technologies	The WPS is used as walkway for accessing and preparing test models in the Ocean Basin. It can also performcontrol-measurements on waves/current/windforce. It has an integrated 3 ton crane. No manriding allowed Parked: accessible for persons
K669-04	Trim Dock Gates	Both	AXtech AS	Automatic gates allowing models from trim dock to OB / SMB. Enables a 'dead zone' inside the trimdock. Provides sealing from basin water when trim dock is drained.
K669-05	Trim Dock Elevation platforms	Both		Elevation platforms attached to the trim docks. Each dock has 1-2 platforms used for, among other things, launching the model, inspecting the model under water, working on the model and preparing the model for test set-up. The trim docks are designed to handle ship models length of max 10 m and height of max 7 m.
Other	ESD (Emergency ShutDown)	Both		
Other	Sintef IT Remote Access	Both		
Other	NTNU IT Remote Access	Both		
Other	Other	Both		

3.3 Building infrastructure

BUT with interlocks that are related to the MIS system will be delivered with interfaces connected to a common fibre network where dedicated cabling for MIS is included. Fibre cable type is single mode, LC terminated.

A number of instrumentation and fibre lockers are installed in vicinity of the equipment, where these cables are terminated and connected to the central network. There are two (2) rack cabinets with 7U each reserved for MIS hardware which will be provided by Company. The racks have the following dimensions: 2053*800*800, and will be placed in two separate IT technical rooms (1 rack in each room). 1840W power is reserved for MIS for each of the two racks.

Reference is made to "Systemskjema IKT" for network topography overview.

4 MIS Scope, Functionality, and Interlock Matrix

4.1 Interlocks

The MIS achieves its control and safety functions by interlocking different components and processes. Interlocks can be mechanical, electrical, or software-based and ensure that actions within the system do not occur unless certain conditions or criteria's are met. It serves as a safety mechanism that

ensures operations within a system are performed in the correct sequence and only under safe circumstances.

In its simplest form, a mechanical interlock might be a physical barrier that prevents machinery from operating unless it is removed or aligned properly. Electrical interlocks could involve sensors or switches that must be activated before an electrical circuit allows an operation to proceed. Software interlocks rely on programming logic to determine whether all the necessary digital conditions are satisfied before moving forward with a process.

For the Main Interlock System at NOTC, it is relevant to incorporate software interlocks that rely on monitoring data and statuses from BUT systems, as well as from supporting systems such as the Hydro Laboratory Centralized Control.

The logic for which systems that have relationships to each other in a MIS context, such that an interlock is needed, is defined by the interlock matrix. The matrix further serves as the configuration documentation for the MIS system setup.

The interlock matrix for NOTC is referenced below.

4.2 MIS system operational scope

The scope of the MIS system and how it relates to other systems in NOTC during normal process operation is visualized below.

The HLCC system is used to plan, design, inititate, control, and end experiments and tests in the SMB and OB.

Each BUT system (for example the *Wave Generation System*) shall govern its own operation with control and safety logic such that all safety related scenarios within the system boundary and capabilities are handled locally.

Activity/System	MIS	HLCC	BUT
Configure experiments/tests/projects			
Initiate start of experiment/test/projects			
Request if safe to start			
Evaluate and approve or deny "safe to start"			
Realtime reporting of status of operation			
Interrupt operation if no longer safe			
Initiate end of experiment/test/projects			
Safe system operation			

Figure 3 Overview of which system governs a given operational activity within SMB/OB. Green color indicates the governing system. Safe system operation is defined as safe according to the Norwegian regulation "Maskinforskriften" (Regulations on Machinery).

4.3 Operational modes

The MIS System is expected to incorporate several main modes of operation:

Mode	MIS status	Description
Normal daily operation	MIS in normal operation	MIS in normal operation. All interlocks and rules are governing systems operation. This includes local control of systems within interlock limits.
External emergency stop signal received	No system operation allowed for any systems in MIS	External Emergency stop signal has been initiated from a BUT system. MIS shall not give any confirmation of “OK to proceed” to any related systems. If any system, for any reason, is still detected as running, MIS shall give a controlled stop command to all relevant interlock systems.
Maintenance	No system operation allowed for any system in the building (OB, SMB, or both)	Maintenance mode has been initiated from an authorised MIS user through the MIS GUI. MIS shall not give any confirmation of “OK to proceed” to any systems in OB, SMB, or both – depending on the scope of maintenance.
Local emergency override	No system operation allowed for any system with related interlocks.	Local emergency override mode has been engaged on a system. For example: “Emergency brake on on FRC”. MIS shall not give any confirmation of “OK to proceed” to any systems interlocked with this system. Not to be confused with local control.
Controlled Stop		Can be initiated from control room or a remote terminal. Can be sent to one or more systems.

External emergency stop signal received, Local emergency override, and Controlled stop modes may be externally triggered – i.e. not initiated from the MIS GUI. Therefore the MIS system shall be able to monitor whether these states have been triggered on any system in scope of MIS through status/monitoring signals.

Engaging from Normal daily operation to Maintenance mode, or from **any mode** back to Normal daily operation shall only be possible for users with sufficient privileges.

4.4 Topology

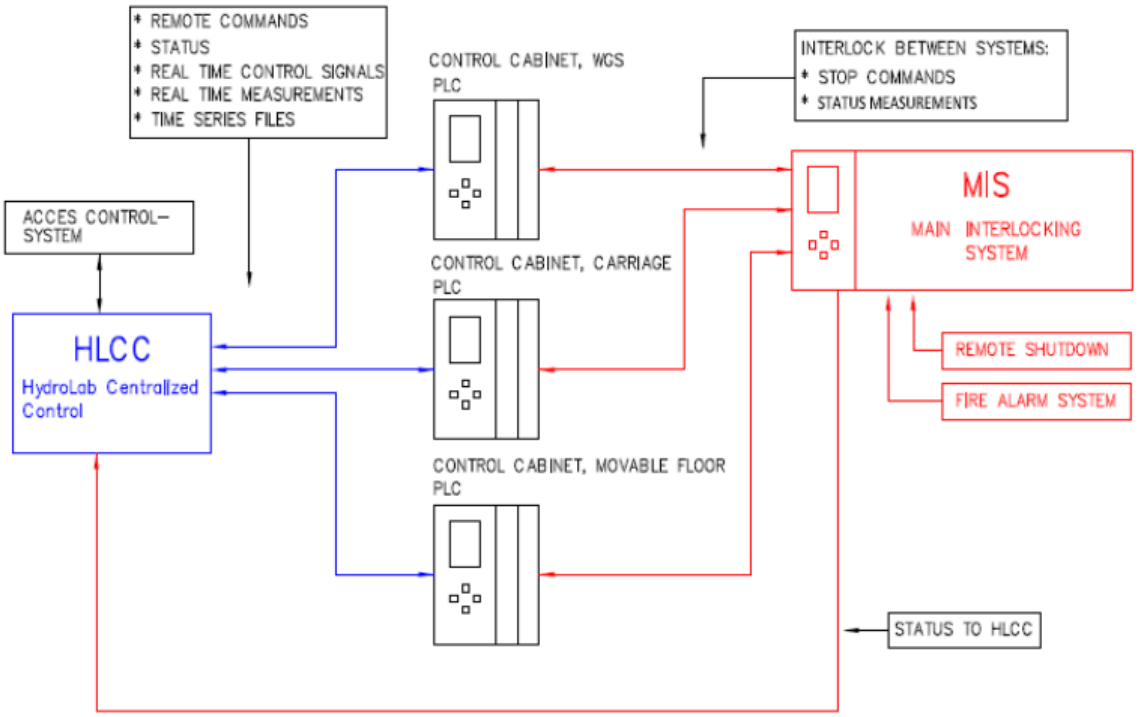

Figure 4 Example of systems that communicate with HLCC and MIS.

4.5 Interlock Matrix

Overview if interlocks for BUT and related systems can be seen below. The full interlock matrix with descriptions per interlock can be found in chapter *2.5 References*.

Systems with interlocks	BAC Building access control system	HLCC Hydrodynamic Laboratory Centralised Control	K669-04 TDG 1 SMB	K669-04 TDG 2 SMB	K669-05 Elevated Platform(s) TDG 1 SMB	K669-05 Elevated Platform(s) TDG 2 SMB	K669-05 Elevated Platform(s) TDG 3 OB	FA Fire Alarm System	SRA Sintef IT Remote Access	WTP Water Treatment Plant	OTH Other	K661-03 CS Pumps	K665-03 FRC	K664-01 MF OB	K664-01 MF SMB	K665-01 MMC	K665-05 RMC	K669-04 TDG 3 OB	K663-02 WAS	K663-02 WAS SMB	K661-02 GVS	K663-01 WAS OB	K662-02 WGS OB	K662-03 WGS SMB	ESD Emergency ShutDown	**Grand Total**
Common	1	3	3	3	3	3	3	3	2	3	4	3	4	3	3	3	3	3	3		3	3	3	3	3	**72**
BA Building Automation Systems								1			1															**2**
BAC Building access control system													1													**1**
ESD Emergency ShutDown		1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1		1	1	1	1		**21**
FA Fire Alarm System	1	1	1	1	1	1	1		1	1		1	1	1	1	1	1	1	1		1	1	1	1	1	**23**
HLCC Hydrodynamic Laboratory Centralised Control								1			1														1	**3**
NRA NTNU IT Remote Access																										
OTH Other		1	1	1	1	1	1			1		1	1	1	1	1	1	1	1		1	1	1	1		**19**
SRA Sintef IT Remote Access																										
WTP Water Treatment Plant								1			1														1	**3**
OB							1	8			6	6		5			5	5			3	5	6		8	**58**
K661-02 GVS								1				1		1								1			1	**5**
K661-03 CS Pumps								1			1			1			1	1			1	1	1		1	**9**
K662-02 WGS OB								1			1	1		1			1	1				1			1	**8**

Systems with interlocks	BAC Building access control system	HLCC Hydrodynamic Laboratory Centralised Control	K669-04 TDG 1 SMB	K669-04 TDG 2 SMB	K669-05 Elevated Platform(s) TDG 1 SMB	K669-05 Elevated Platform(s) TDG 2 SMB	K669-05 Elevated Platform(s) TDG 3 OB	FA Fire Alarm System	SRA Sintef IT Remote Access	WTP Water Treatment Plant	OTH Other	K661-03 CS Pumps	K665-03 FRC	K664-01 MF OB	K664-01 MF SMB	K665-01 MMC	K665-05 RMC	K669-04 TDG 3 OB	K663-02 WAS	K663-02 WAS SMB	K661-02 GVS	K663-01 WAS OB	K662-02 WGS OB	K662-03 WGS SMB	ESD Emergency ShutDown	**Grand Total**
K663-01 WAS OB								1			1	1		1				1			1		1		1	**8**
K664-01 MF OB								1			1	1					1				1	1	1		1	**8**
K665-05 RMC							1	1			1	1		1				1					1		1	**8**
K669-04 TDG 3								1			1	1					1					1	1		1	**7**
K669-05 Elevated Platform(s) TDG 3 OB								1									1	1					1		1	**5**
SMB	1		5	5	2	3		9			7		6		4	8			6					8	9	**73**
K662-03 WGS SMB			1	1				1			1		1		1	1			1						1	**9**
K663-02 WAS SMB			1	1				1			1		1		1	1								1	1	**9**
K664-01 MF SMB								1			1		1			1			1					1	1	**7**
K665-01 MMC			1	1	1	1		1			1		1		1				1					1	1	**11**
K665-03 FRC	1		1	1		1		1			1				1	1			1					1	1	**11**
K669-04 TDG 1 SMB					1			1			1					1			1					1	1	**7**
K669-04 TDG 2 SMB						1		1			1		1			1			1					1	1	**8**
K669-05 Elevated Platform(s) TDG 1 SMB			1					1								1								1	1	**5**
K669-05 Elevated Platform(s) TDG 2 SMB				1				1					1			1								1	1	**6**
Grand Total	**2**	**3**	**8**	**8**	**5**	**6**	**4**	**20**	**2**	**3**	**17**	**9**	**10**	**8**	**7**	**11**	**8**	**8**	**9**		**6**	**8**	**9**	**11**	**20**	**203**